GHB
FYI
JHN

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: S. Gale Chapman

FROM: Dennis K. Killian

DATE: March 23, 1997

SUBJECT: Interim Report on Burning PRB Coal at IGS

We have recently completed the first portion of an ongoing evaluation regarding subbituminous C coal from the Wyoming Powder River Basin (PRB), as a fuel at the Intermountain Generating Station. Having burnt one train of PRB coal at IGS, this coal appears to be a viable alternative fuel in blending rates up to approximately 50% provided economical transportation is available.

From the operational parameters monitored during consumption of the PRB coal on Wednesday March 12th and Friday March 14th there are no concerns which would preclude burning PRB at Intermountain Generating Station. There are, however, several items that warrant further evaluation before making a long-term decision on PRB consumption or maximum blending rates.

Blend rates of PRB coal during the initial burn on March 12th are not well established. Considerable effort was made by Operations to follow established guidelines, however, plow reliability did not allow for consistent blending. Therefore, it is difficult to draw conclusions from the PI data associated with this incident.

The investigation and testing completed on Friday March 14th, however, has allowed us to verify potential concerns in both operation and maintenance. These include:

-Increased fire and explosion potential
-Reduced operational margins
-Reduced equipment maintenance availability
-Fuel delivery concerns
-Increased house cleaning

<u>Increased Fire/Explosion Potential</u>
The increased propensity of PRB fuels to ignite within the fuel handling and preparation systems is an established concern in the industry. The basis for this concern was noted during our test burn.

Wyoming

During the test period the pulverizer inlet temperatures were observed to increase an average of 100 degrees above normal. Pulverizer inlet temperatures reached 470 degrees F in some cases. Outlet temperatures were controlled within allowable limits during this test. According to B&W, pulverizer inlet temperatures above 400 degrees F place us in a fuel category where they no longer recommend sweeping to the furnace due to explosion concerns.

Reduced Operational Margins

During the test it was noted that fuel preparation systems operated closer to capacity, as expected. This will continue to be a concern, at least until rescaling is complete on both units.

During the tests feeder speeds were recorded at 83%, 10-12% above normal. Also, pulverizer differentials rose by 2-3 inches w.g. Operation at these levels over time has an incremental cost associated with increased power consumption and increased maintenance requirements.

Reduced Equipment Maintenance Availability

Several attributes of PRB coal make maintenance of associated systems more difficult. At a blend rate of 50% an approximate 15% greater volume of coal must be handled and crushed based on average BTU content. This reduces available maintenance time by approximately three hours in each 24 hour period.

Plants we have contacted tell us that the higher fuel flow rates for PRB result, as expected, in notably higher maintenance requirements. Increased pulverizer maintenance requirements are compounded by decreased maintenance access time of conveying and pulverizing equipment as well as potential equipment capacity reduction (i.e. mill outlet temperature constraints requiring more mill capacity).

In addition, fuel handling system reliability, including rotary plows, will require additional modifications to ensure long-term, reliable blending capability.

Fuel delivery concerns

The ability of IPSC to provide adequate coal transport capacity is in question. Additional train capacity may be needed. An assessment of existing rail capacity and schedules will require information currently available only within the DWP fuels group.

Increased house cleaning

During the test a considerable increase was noted in coal dust at conveying transfer points. This issue was also identified to us by others with PRB experience. House cleaning requirements will increase.

In addition to the above concerns, longer term testing would be required to fully evaluate boiler gas side impacts including sootblowing capability by section and reheat temperature control. As described in the PRB plan submitted earlier, water lances and primary air duct burners are common retrofit provisions in plants burning predominantly PRB.

Following burn of the upcoming March 26, 1997, PRB shipment we will provide an updated report. The concerns noted above, with exception of coal transport, appear to have solutions that could be justified and addressed within our normal budgeting process.

JHN:dh

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: Jerry Hintze

FROM: Jim Nelson

DATE: March 10, 1989

SUBJECT: IPSC's Comments on Wyoming Coal

FILE: 01.12.09 & 43.1200

LADWP is currently investigating the purchase of coal from mines located in south central Wyoming. From the information available here at the site, there appears to be several operational questions which deserve careful evaluation before any commitments are made. Among them are the following:

FINES - According to available information, the south central Wyoming coals have an average HGI well above IPSC's existing sources. Typically, this means higher fines. A study should be conducted to investigate any increase in negative effects on the fuel handling area and equipment.

MOISTURE - Available information suggests that the average total moisture of the coal under consideration is approximately twice that of current sources. Inherent or capillary moisture is approximately three times that of current sources. This presents several more concerns.

Unloading difficulties are, at least in part, associated with higher moisture content of "as received" coal. Doubling the total moisture would doubtless have a worsening effect on cold weather unloading.

In recent weeks, as coal moisture has climbed to 10-11%, pulverizer inlet gas temperatures increased an average of 65 to 75 degrees. A significant increase in mill fires was noted and differential pressures were reaching alarm limits.

Concerns also exist with regard to primary air fan capacity. Due to the reported "clumping" tendency of the Wyoming coal, greater fan capacity may be required to provide proper classification at required fuel flows.

Six mill operation with current coal characteristics is often marginal. The analyses of the Wyoming coal suggest that six mill operation may be impossible.

BLENDING - Reliable blending requires a highly reliable system. This includes availability of on-site equipment and consistency of coal inventories.

There is guarded optimism that the rotary plow feeder reliability can be improved significantly. However, the degree of reliability required to effectively blend coal has not yet been demonstrated by the reclaim system in general.

IPSC has had considerable difficulty in maintaining a consistent fuel reserve in the active reclaim area. Available coal quantities would have to be maintained within much tighter tolerances than has occurred to date.

SLAGGING/FOULING - Slagging problems have been reported by one utility (NIPSCO) burning the coal in question. Reflective buildup throughout the back pass produced heat transfer problems according to Mr. Larry Bonner of NIPSCO (219) 853-6956. Resolution of these problems required the unit to be shut down.

It appears that the use of Wyoming coal may require significant alterations in existing equipment and/or modes of operation. Whether desirable or not, these issues should be thoroughly investigated.

JHN:tdt

cc: Dennis Killian

INTERMOUNTAIN POWER SERVICE CORPORATION
COAL DATABASE

DATE: JANUARY 17, 1989
SAMPLE RECEIVED AT IGS: 12-20-88
MINE: "C" SAMPLE

REQUESTED BY: LADWP FUELS GROUP, BILL ENGELS

COAL ANALYSES

IPSC LAB

	LAB NO. 6164 AS RECEIVED	DRY BASIS	LAB NO. AS RECEIVED	DRY BASIS
% MOISTURE	12.34 12.60	XXXX	XXXX	XXXX
% ASH	4.73 4.59	5.40	XXXX	XXXX
% VOLATILE	38.42	43.83	XXXX	XXXX
% FIXED CARBON (by diff.)	44.51	50.77	XXXX	XXXX
% SULFUR	0.55	0.63	XXXX	XXXX
BTU/LB	11255 11,150	12839	XXXX	XXXX
% FLOURINE			XXXX	XXXX
	HGI = 54.7		HGI = XXXX	

ASH ANALYSES

	IPSC LAB	MINE SPLIT
% SODIUM OXIDE, Na_2O, IGNITED BASIS =	0.73	XXXX
FUSION TEMPERATURES, REDUCING ATMOSPHERE; ID=	2440	XXXX
ST=	2450	XXXX
HT=	2455	XXXX
FT=	2460	XXXX

NON-AGGLOMERATING.

INTERMOUNTAIN POWER SERVICE CORPORATION
COAL DATABASE

DATE: JANUARY 17, 1989
SAMPLE RECEIVED AT IGS: 12-21-88
MINE: "B" SAMPLE

REQUESTED BY: LADWP FUELS GROUP, BILL ENGELS

COAL ANALYSES

IPSC LAB

	LAB NO. 6171 AS RECEIVED	LAB NO. 6171 DRY BASIS	LAB NO. AS RECEIVED	LAB NO. DRY BASIS
% MOISTURE	16.22 - 16.[illegible]	XXXX	XXXX	XXXX
% ASH	5.25 4.94	6.27	XXXX	XXXX
% VOLATILE	36.54	43.61	XXXX	XXXX
% FIXED CARBON (by diff.)	41.99	50.12	XXXX	XXXX
% SULFUR	0.85	1.01	XXXX	XXXX
BTU/LB	10656 1066[illegible]	12719	XXXX	XXXX
% FLOURINE			XXXX	XXXX
	HGI = 49.5		HGI = XXXX	

ASH ANALYSES

	IPSC LAB	MINE SPLIT
% SODIUM OXIDE, Na_2O, IGNITED BASIS =	0.18	XXXX
FUSION TEMPERATURES, REDUCING ATMOSPHERE; ID=	2265	XXXX
ST=	2370	XXXX
HT=	2395	XXXX
FT=	2610	XXXX

NON-AGGLOMERATING

~~Add~~ to Jim Nelson list

CONCERNS - COAL QUALITY CHANGE

Nissen
3/14/89

Wyoming COAL fired @ IGS

Impacts:

- Change ~~s~~ tuning on Combustion Controls
  w/ different HHV + ~~Ultimate~~ approximate analysis   ↑ coal ↑ air
  F-A Ratio change / O_2 trim / ↑ secondary airflow - ↑ fan capacity (windbox damper posit
  PA flow requirements - adequate drying   ↑ Moist   ↑ airflow
  temp controls: MSttm, HRH, Sprays, Bias Dampers
  firing ~~rates~~, etc. etc.   press control

- concerns w/ equipment performance, operation and maintenance

Boiler ↓ performance efficiency due to increase dry gas loss (inc mass transfer) ~~possibly~~ higher FEGT / EGOT due to dry gas loss plus inc in fouling/slagging CF, ↑ FEGT will ↑ NO_x levels
~~???~~ impact on boiler capacity / rating?

Pulverizers decrease in capacity   inc in HP / output requirements
  inc maintenance / inc wear, inc pyrites   change in PM or 3000 hr schedu
  inc in Fire + Explosion potential due to VM inc
  inc inerting requirements / mandatory usage of inert system
  sweep + clear to furnace, no longer acceptable practice
  fineness concerns / LOI's

Burners unknown impact on operation
  change in F-A ratio / register changes? O_2 profiles
  turndown to 30%? / scanner - flame quality adjustments?
  NO_x control - formation levels acceptable?
inc potential for ... in Burners / ... due to change of F-A ratio in burner...

IP12_004809

FANS

FD inc sec air flow inc HP-Aux Pwr
~~inc draft loss due to inc fouling~~ ~~inc HP~~

PA Fan inc capacity requirements due to inc coal flow inc HP-Aux Pwr
NOTE: Fans are border line (Deficiency Item)

ID fans inc gas flow inc HP-Aux Pwr due to inc air flow plus draft loss due to inc fouling
inc wear/erosion rates already ~~concern~~ problem with wear rates

Sootblowing: inc fouling/slagging will increase sootblowing requirements / steam consumption, inc gas draft due to fouling
evaluate press setpoints for effective cleaning
evaluate blowing intervals / frequency

RAH evaluate coldend corrosion (sulfur) potential
maintain ACET (more stringent)
PAH heating requirements will increase ↑M content
air leakage will inc due to draft loss inc (with RAH as well as entire gas path

APH inc water usage due to maintaining more stringent ACET requirements

Tube Metal concerns with tube metal temps & overheating
concerns w/ tube wastage at burning zone (oxidation vs reducing zone

Coal Handling   inc coal requirements   inc Aux Power
inc # trains | amount handling | etc. etc

Blending Requirements   operational consideration
(need multiple rotary plows available)

Ash Handling
inc bottom ash | pyrites | econ ash | RAH ash | flyash - baghouse
inc aux power consumption | water usage
inc landfill + ash handling requirements

Baghouse   change in flyash characteristics   will influence ash cake and
operation and performance of baghouse
inc opacity | particulate emission   inc aux pwr

Scrubber   inc sulfur content and characteristics | changes scrubber
operation + tuning   inc # modules I/S due to inc gas flow

CGR   inc water usage FOR due to inc gas flow
↓HR

Sludge conditioning   will change sludge characteristics
and operation - control sludge conditioning
pug mills   vacuum filters   etc

Limestone Handling
inc limestone requirements | Ball mill usage   aux power

Emissions

impact emission rates for

- ↑ Opacity / Particulate Emission
- ↑ SO_2 removal rates / SO_2 emission
- ↑ NOx emission rate

~~→ permit variance requirements~~

COAL Characteristics?

Need to know impact of coal quality
~~Ultimates / proximate analysis~~

HHV
Ash
Sulfur
Na
HGI

VM
Moist
etc.

Ash Characteristics

Need to know impact of

Ash Fusion Temps
fouling / slagging indices
etc.

IP12_004812

Unit Heat Rate will worsen

dec Boiler Perf
inc RAH leakage

Inc Aux Power Requirements
Pulv | FD Fan | PA fan | ID fan | feeders
Baghouse | Scrubber coal handling | ash handling | etc.

inc ~~Aux~~ Steam for Sootblowing requirements
inc CGR (FGR) requirements
inc APH water usage
translates to dec turbine cycle heat rate

Boiler Performance

potential capacity derate of boiler
based on slagging / fouling - ability to make Mstm + HRH temps?
Fan capacities PA Fan questionable

Coal Sampling + testing
become much more critical for accurate evaluation

Recommend:

1) Full impact evaluation on: conduct modeling
performance
maintenance
operation

2) Test Burn testing should be required to fully evaluate full impact

3) Adding B&W Diag 140 Perf Evaluation Program to evaluate on line ~~[illegible]~~ operational & perf. effects

What are the fuel costs & actual potential $ savings
cost-benefit ratio

SGC For your
MAR 9 1989 formation
I. Stein

Babcock & Wilcox

a McDermott company

Power Generation Group

20 S. Van Buren Avenue
P.O. Box 351
Barberton, OH 44203-0351
(216) 753-4511

February 1, 1989

Intermountain Power Project
Department of Water & Power
City of Los Angeles
P.O. Box 111, Room 658
Los Angeles, CA 90051

Attn: Mr. T.H. McGuiness

Re: Intermountain Power Project
B&W Ref: RB-614/615
Subject: Coal Evaluation

Gentlemen:

At the request of Bill Ingalls and Raffi Krikorian, three coals samples were analyzed by B&W for the primary purpose of determining slagging and fouling indices per B&W's established standard methods. Fuel testing included determination of proximate and ultimate analysis, gross heating value, ash fusion temperatures (oxidizing and reducing), spectrographic ash analysis, and grindability. The three coal samples were labeled Coal A, Coal B, and Coal C. Coal A was identified by IPP as being coal currently in use at our contract, RB-614/615. No data concerning the origin of Coals B or C was provided. According to previous conversations with IPP, Coals B and C are candidate coals being considered for firing on these units.

The analysis data for the three coal samples is attached to this report. Also attached is a table of calculated results which are pertinent to the discussion that follows.

COAL RANK

Coal ranks were determined in accordance with ASTM specifications. In the case of the three fuels tested, ranking is somewhat complicated by the fact that all three coals fall into the classification range where the rank cannot be specifically defined by proximate analysis data. All three coals have moist, ash free Btu values in the range of 11,000 to 13,000 Btu/lb. ASTM ranking criteria assigns both the High Volatile C Bituminous classification and the Subbituminous A classification to this Btu range. Generally, the agglomerating characteristics of the coal are used to differentiate between these adjacent groups. Agglomerating coals are commonly ranked in the High Volatile C Bituminous group, while non-agglomerating coals are commonly ranked in the Subbituminous A group. When this issue became apparent, we performed additional tests in accordance with ASTM standard D388 to determine the agglomerating characteristics of the coals. Coal A was found to be agglomerating while Coals B and C were non-agglomerating. This would result in a High Volatile C Bituminous rank for Coal A and Subbituminous A for Coals B and C. It should be noted, however, that there are some non-agglomerating coals in bituminous classifications so the specific rankings in this "gray area" are not hard and fast. However, the specific ranks of the coals are not critical to the determination of slagging and fouling characteristics which are most dependent upon the coal ash chemistry.

SLAGGING AND FOULING CHARACTERISTICS

The slagging and fouling indices developed by B&W are specific to the type of coal ash being considered. There are two major coal ash classifications, i.e. "eastern" and "lignitic". Classification is determined by the calculation of the lignitic factor which is the ratio of the percent by weight of calcium and magnesium in the coal ash to the percentage of iron. When this ratio is less than 1 the ash classification is eastern, when the lignitic factor is greater than 1 the ash classification is lignitic. This distinction is critical for the selection of correlations to be used for determining slagging and fouling characteristics. Per the above the ash is characterized as lignitic for Coals A and C and eastern for Coal B.

SLAGGING

The slagging factor (R_s) for a lignitic ash coal is calculated from a weighted average of the initial deformation and hemispherical softening temperatures of the coal ash. Classification is as follows:

R_s GT 2250	= medium slagging
R_s 2250 - 2100	= high slagging
R_s LT 2100	= severe slagging

Based on the above, the lignitic ash coals, A and C, classify as high and medium respectively.

The slagging factor for an eastern ash coal is calculated as the product of the base to acid ratio of the coal ash and the percent by weight of sulfur in the coal on a dry basis. Classification is as follows:

R_s LT 2.0	= medium slagging
R_s 2.0 - 2.6	= high slagging
R_s GT 2.6	= severe slagging

Coal B, which has an eastern type ash, is classified on this basis as medium slagging.

FOULING

The fouling factor (R_f) for a lignitic ash coal is determined by the weight percent of sodium (Na) in the ash analysis. Two classification criteria are utilized, depending on the base to acid ratio of the coal ash. For ash with a low B/A, classification is as follows:

R_f LT 1.2	= medium fouling
R_f 1.2 - 3.0	= high fouling
R_f GT 3.0	= severe slagging

Coal A falls in this category and is classified as high fouling with a sodium content of 1.46.

Ash with a low base to acid ratio is classified for fouling as follows:

R_f LT 3.0 = medium fouling

R_f 3.0 - 6.0 = high fouling

R_f GT 6.0 = severe fouling

Coal C with a high B/A and a sodium content of .84 is classified as medium fouling on this basis.

The fouling factor for an eastern ash coal is calculated as the product of the base to acid ratio and the weight percent of sodium in the ash. Classification is as follows:

R_f LT 0.5 = medium fouling

R_f 0.5 - 1.0 = high fouling

R_f GT 1.0 = severe fouling

Coal B, with R_f of .09, is classified on this basis as medium fouling.

SPECIAL NOTE ON COAL C

Per the above, in accordance with our standard predictive methods for coals with lignitic ash, Coal C is classified as medium slagging and medium fouling. Relatively recent experience with western coals from certain areas in Montana and Wyoming indicate that these coals do not behave in accordance with the standard indices and special considerations are required. These coals have exhibited the potential to form thin, white, highly reflective ash deposits on upper furnace walls. These deposits impede radiant heat transfer in the furnace resulting in elevated furnace exit gas temperatures (FEGT). Problems with severe superheater leading edge slagging can result from the higher than expected gas temperature.

At present, there is no proven method of determining if a particular ash will exhibit reflective properties with a high degree of certainty. However, a number of parameters associated with Coal C such as its high Base/Acid ratio, lignitic factor and calcium content are common to other coals known to have reflective ash properties. As noted above, Montana and Wyoming coals from certain seams are known to have reflective properties. IPP declined to advise the origin of these coals prior to issuing this report so no evaluation can be made on this basis.

FLYASH EROSION POTENTIAL

Based on the analyses data available, a limited evaluation of the erosiveness of the various coal ash can be made. Factors considered from the coal and ash analysis include ash loading, expressed as pounds of ash per million Btu, and the sum of silica and alumina in the ash. High ash loadings and high silica/alumina contribute to increased flyash erosion. In convection pass design, flue gas velocity limits are established based, in part, on these factors.

Table 1 shows the ash loading Si + Al calculations for the three coals tested. Note that Coal A has both the highest ash loading and the highest total silica/alumina of the three coals. Ash loadings are significantly less for Coals B and C. Coal C also has a significantly lower proportion of erosive elements.

IGNITION AND STABILITY

B&W has developed a number of indices to evaluate ignition and stability characteristics for the wide range of fuel/burner/furnace combinations encountered. Presently, our most commonly used index is the B&W Ignition Factor.

This factor provides a relative indication of ignition and stability characteristics for PC firing by evaluating volatile heat release and ignition burden factors. Experience has shown a very good correlation between the ignition factor and observed performance over a wide range of combustion system configurations and coal types.

Generally, fuels having ignition factors of 120 or greater can readily be utilized in conventional furnaces with standard circular or Dual Register Burners. Ignition factors for the three fuels included in this study are listed on Table 1. Note that the factors for all three fuels significantly exceed the minimum requirements.

SUMMARY

Aside from the question concerning the potential that Coal C has a reflective ash, the evaluation indicates that Coals B and C could readily be used to replace Coal A. On the basis of the standard indices evaluated these coals exhibit advantages with respect to Coal A in terms of slagging and fouling performance and flyash erosion potential. The potential for reflective ash with Coal C will require additional evaluation since the standard indices do not adequately predict performance when reflective ash effects are involved. Information concerning the source of Coal C will help to resolve this issue.

Very truly yours,

Carl O Palmberg

C.A. Palmberg, Contract Manager

CAP:nk

cc: RK Krikorian - IPP, LA
GT Rose - IPP, Delta

P.S. - Per my 1/27/89 telecon with Bill Ingalls, IPP is sending us one more candidate coal ("Coal D") for similar analysis work. B&W will report on "Coal D" in a separate report. Please initiate a change order to cover this additional work (price is the same as quoted in my 11/23/88 letter).

Table 1

	Coal A	Coal B	Coal C
Coal Rank	HVBC/SUBA	HVBC/SUBA	HVBC/SUBA
Lignitic Factor	1.91	.85	4.36
Ash Type	Lignitic	Eastern	Lignitic
B/A Ratio	.31	.31	1.19
Sulfur % Dry	.66	1.04	.60
Na %	1.46	.30	.84
R_s	2184 (high)	.32 (medium)	2390 (medium)
R_f	1.46 (high)	.09	.84 (medium)
# Ash/10^6 Btu	6.4	4.7	4.1
Si + Al	67.92	66.68	36.15
Ignition Factor	379	240	315

INTERMOUNTAIN POWER
DELTA, UTAH
ACG-89-6366-01
JANUARY 13, 1989

Sample No.	C-20112		C-20113	
Description	COAL A (Skyline) 12/5/88		COAL B (Bitter Creek) 12/5/88	
Basis	As Received	Dry	As Received	Dry
Total Moisture, %	11.24	—	16.06	—
Proximate Analysis, %				
Moisture	11.24	—	16.06	—
Volatile Matter	39.84	44.89	35.84	42.70
Fixed Carbon	41.57	46.83	43.16	51.41
Ash	7.35	8.28	4.94	5.89
Gross Heating Value Btu per Lb.	11453	12903	10569	12591
Btu per Lb. (M&A Free)	—	14068	—	13379
Ultimate Analysis, %				
Moisture	11.24	—	16.06	—
Carbon	62.71	70.65	60.73	72.35
Hydrogen	4.83	5.44	4.21	5.02
Nitrogen	1.33	1.50	1.19	1.42
Sulfur	0.59	0.66	0.87	1.04
Ash	7.35	8.28	4.94	5.89
Oxygen (Difference)	11.95	13.47	12.00	14.28
Total	100.00	100.00	100.00	100.00

INTERMOUNTAIN POWER
DELTA, UTAH
ACG-89-6366-01
JANUARY 13, 1989

Sample No.	C-20114	
Description	COAL C (Shoshone) 12/3/88	

Basis	As Received	Dry
Total Moisture, %	12.82	--
Proximate Analysis, %		
Moisture	12.82	—
Volatile Matter	38.99	44.72
Fixed Carbon	43.60	50.01
Ash	4.59	5.27
Gross Heating Value Btu per Lb.	11150	12790
Btu per Lb. (M&A Free)	—	13502
Ultimate Analysis, %		
Moisture	12.82	—
Carbon	63.61	72.96
Hydrogen	4.54	5.21
Nitrogen	1.53	1.75
Sulfur	0.52	0.60
Ash	4.59	5.27
Oxygen (Difference)	12.39	14.21
Total	100.00	100.00

89 00147 AG

Paul Chaffee

For your in
I. Stein

Babcock & Wilcox

a McDermott company

Power Generation Group

20 S. Van Buren Avenue
P.O. Box 351
Barberton, OH 44203-0351
(216) 753-4511

March 3, 1989

Intermountain Power Project
Department of Water & Power
City of Los Angeles
P.O. Box 111, Room 658
Los Angeles, CA 90051

Attn: Mr. T.H. McGuiness

Re: Intermountain Power Project
B&W Ref: RB-614/615
Subject: Coal Evaluation

Gentlemen:

As an addition to the coal evaluation study provided previously, IPP submitted a fourth coal sample, Coal D, for evaluation. Laboratory tests were conducted consistent with the procedures used to evaluate the three coals included in the initial study.

Analysis data for Coal D is attached. For comparison purposes, Table 1 has been revised to include results for Coal D.

Coal D is classified as a High Volatile B Bituminous coal. The coal ash is classified as Lignitic. The slagging factory (R_s) is 2288 which results in a medium slagging classification. The slagging factor for Coal D falls approximately midway between the slagging factors for Coal A and Coal C.

As a result of the high sodium content (5.39%), the fouling factor (R_f) for Coal D is severe. Coal D has a low base to acid ratio (.31) which is identical to that of Coal A and classified for fouling on the same basis. The severe fouling classification applies to coals with greater than 3% sodium. Coal D is significantly beyond this limit and we would anticipate a significant increase in fouling problems relative to Coal A. It should also be noted that, relative to all of the other coals evaluated in this study, Coal D also has a significantly higher ash content. On a pounds per million Btu basis, the ash content of Coal D is approximately 40% higher than Coal A and almost twice that of Coals B and C.

As noted in our initial report, Coal C was identified as having properties associated with reflective ash coals. Coals A, B, and D do not exhibit reflective ash properties. Subsequent to the release of our previous report, IPP advised that Coal C was from the Hanna Basin in southern Wyoming. Wyoming coals known to have reflective ash characteristics are from the Powder River Basin in the northeast corner of the state. Based on this information, there is a significantly lower potential that Coal C will exhibit problems associated with reflective ash. However, due to the uncertainties that exist with respect to the predictive methods that are currently available, we would caution IPP to carefully evaluate the impact of Coal C on FEGT and SSH slagging if a test burn of this fuel is conducted.

Another question that developed from our initial report pertains to the ASTM rank classification for Coals B and C. As previously reported, both of the coals exhibited non-agglomerating characteristics which are normally associated with Subbituminous coals. However, per ASTM criteria, there is one variety of High Volatile C Bituminous coal that is also non-agglomerating. In order for a non-agglomerating coal to be classified as Bituminous it must also be nonweathering. Weathering refers the tendency of low rank coals to break apart when they dry out. The breakage being increased by repeated wetting and drying, as by exposure to weather. According to the Fuels section of our research center there is no ASTM method to test for weathering characteristics. The available literature refers to a U.S. Bureau of Mines method which would require coal samples between 1 and 1.5 inches in size. Since coal samples were not available in this size range and B&W's research center had no experience or familiarity with the test method, the weathering test could not be conducted. Therefore, the specific rankings of Coals B and C remain questionable.

If you have questions or comments, please advise.

Very truly yours,

C.A. Palmberg
Contract Manager

CAP:nk

cc: W Engels - IPP, LA
RK Krikorian - IPP, LA
GT Rose - IPP, Delta

CAP4464

89 00147 AG

Paul Chaffee

For your in
I. Stein

Babcock & Wilcox

a McDermott company

Power Generation Group

20 S. Van Buren Avenue
P.O. Box 351
Barberton, OH 44203-0351
(216) 753-4511

March 3, 1989

Intermountain Power Project
Department of Water & Power
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Attn: Mr. T.H. McGuiness

Re: Intermountain Power Project
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Subject: Coal Evaluation

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Analysis data for Coal D is attached. For comparison purposes, Table 1 has been revised to include results for Coal D.

Coal D is classified as a High Volatile B Bituminous coal. The coal ash is classified as Lignitic. The slagging factory (R_s) is 2288 which results in a medium slagging classification. The slagging factor for Coal D falls approximately midway between the slagging factors for Coal A and Coal C.

As a result of the high sodium content (5.39%), the fouling factor (R_f) for Coal D is severe. Coal D has a low base to acid ratio (.31) which is identical to that of Coal A and classified for fouling on the same basis. The severe fouling classification applies to coals with greater than 3% sodium. Coal D is significantly beyond this limit and we would anticipate a significant increase in fouling problems relative to Coal A. It should also be noted that, relative to all of the other coals evaluated in this study, Coal D also has a significantly higher ash content. On a pounds per million Btu basis, the ash content of Coal D is approximately 40% higher than Coal A and almost twice that of Coals B and C.

As noted in our initial report, Coal C was identified as having properties associated with reflective ash coals. Coals A, B, and D do not exhibit reflective ash properties. Subsequent to the release of our previous report, IPP advised that Coal C was from the Hanna Basin in southern Wyoming. Wyoming coals known to have reflective ash characteristics are from the Powder River Basin in the northeast corner of the state. Based on this information, there is a significantly lower potential that Coal C will exhibit problems associated with reflective ash. However, due to the uncertainties that exist with respect to the predictive methods that are currently available, we would caution IPP to carefully evaluate the impact of Coal C on FEGT and SSH slagging if a test burn of this fuel is conducted.

T.H. McGuiness
B&W Ref: RB-614/615
Page 2

March 3, 1989

Another question that developed from our initial report pertains to the ASTM rank classification for Coals B and C. As previously reported, both of the coals exhibited non-agglomerating characteristics which are normally associated with Subbituminous coals. However, per ASTM criteria, there is one variety of High Volatile C Bituminous coal that is also non-agglomerating. In order for a non-agglomerating coal to be classified as Bituminous it must also be nonweathering. Weathering refers the tendency of low rank coals to break apart when they dry out. The breakage being increased by repeated wetting and drying, as by exposure to weather. According to the Fuels section of our research center there is no ASTM method to test for weathering characteristics. The available literature refers to a U.S. Bureau of Mines method which would require coal samples between 1 and 1.5 inches in size. Since coal samples were not available in this size range and B&W's research center had no experience or familiarity with the test method, the weathering test could not be conducted. Therefore, the specific rankings of Coals B and C remain questionable.

If you have questions or comments, please advise.

Very truly yours,

C.A. Palmberg
Contract Manager

CAP:nk

cc: W Engels - IPP, LA
RK Krikorian - IPP, LA
GT Rose - IPP, Delta

CAP4464

Table 1

	Skyline Coal A	Bittercreek Coal B	Shoshone Coal C	Trail Mountain Coal D
Coal Rank	HVBC/SUBA	HVBC/SUBA	HVBC/SUBA	HVBB
Lignitic Factor	1.91	.85	4.36	2.3
Ash Type	Lignitic	Eastern	Lignitic	Lignitic
B/A Ratio	.31	.31	1.19	.31
Sulfur % Dry	.66	1.04	.60	.49
Na %	1.46	.30	.84	5.39
R_s	2184 (high)	.32 (medium)	2390 (medium)	2288 (medium)
R_f	1.46 (high)	.09 (medium)	.84 (medium)	5.39 (severe)
# Ash/10^6 Btu	6.4	4.7	4.1	8.9
Si + Al	67.92	66.68	36.15	68.65
Ignition Factor	379	240	315	373

IP12_004826

INTERMOUNTAIN POWER
DELTA, UTAH
ACG-89-6407-01
FEBRUARY 20, 1989

Sample No.	C-20155
Description	Coal Sample "D" taken @ C.V. SPUR by CF & C 2/2/89
Grindability (ASTM D-409)	43

Ash Analysis (Spectrographic), %

Silicon as SiO_2	46.01
Aluminum as Al_2O_3	22.64
Iron as Fe_2O_3	4.64
Titanium as TiO_2	1.15
Calcium as CaO	8.68
Magnesium as MgO	1.97
Sodium as Na_2O*	5.39
Potassium as K_2O*	0.64
Sulfur as SO_3	5.39
Phosphorus as P_2O_5	0.81

Ash Fusion Temperatures, ^{O}F

Atmosphere	Red.	Oxid.
A (I.D.)	2270	2280
B (S.T., Sp)	2330	2340
C (S.T., HSp)	2360	2360
D (F.T., 1/16")	2400	2370
E (F.T., Flat)	2740	2750+

** By Flame Photometer.

INTERMOUNTAIN POWER
DELTA, UTAH
ACG-89-6407-01
FEBRUARY 20, 1989

Sample No.	C-20155	
Description	Coal Sample "D" taken @ C.V. SPUR by CF & C 2/2/89	
Basis	As Received	Dry
Total Moisture, %	7.41	—
Proximate Analysis, %		
Moisture	7.41	—
Volatile Matter	38.71	41.81
Fixed Carbon	43.45	46.93
Ash	10.43	11.26
Gross Heating Value Btu per Lb.	11763	12704
Btu per Lb. (M&A Free)	--	14316
Ultimate Analysis, %		
Moisture	7.41	--
Carbon	65.46	70.70
Hydrogen	4.87	5.26
Nitrogen	1.29	1.39
Sulfur	0.45	0.49
Ash	10.43	11.26
Oxygen (Difference)	10.09	10.90
Total	100.00	100.00
Agglomerating character	Agglomerating	

WYOMING COAL MEETING

AGENDA

Purpose: To organize specific concerns within IPSC regarding the potential burn of Wyoming Coal at IGS.

The potential purchase of Wyoming coal has raised several concerns regarding the possible effect(s) on station availability, reliability and heat rate both immediate and projected. IPSC's objective is, of course, to maintain and/or improve these parameters as far as possible.

IPSC management has requested that those associated with coal quality/characteristics, assemble the specific concerns.

Three groups have been identified into which each identified concern should be placed:
1-Items likely requiring system or equipment re-tuning.
2-Items likely requiring alteration in existing operating mode.
3-Items likely requiring hardware modifications.

Within each of these three groups at least two catagories should be identified:
A-High probability for potential problems
B-Significant probability for potential problems

Each item identified should be catagorized (i.e. 1A, 3B etc.) for recognition of relative priority.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: Jerry Hintze

FROM: Jim Nelson

DATE: 3/7/89

SUBJECT: IPSC Comments on Wyoming Coal

FILE: 43.1200

LADWP is currently investigating the purchase of coal from mines located in south central Wyoming. From the information available here at the site, there appear to be several operational questions which deserve careful evaluation before any committments are made. Among them are the following:

FINES-According to available information, the southern central Wyoming coals have an average HGI well above IPSC's existing sources. Typically, this means higher fines. A study should be conducted to investigate any increase in negative effects on the fuel handling area and equipment.

MOISTURE-Available information suggests that the average total moisture of the coal under consideration is approximately twice that of current sources. Inherent or capillary moisture is approximately three times that of current sources. This presents several more concerns.

Unloading difficulties are, at least in part, associated with higher moisture content of 'as received' coal. Doubling the total moisture would doubtless have a worsening effect on cold weather unloading.

In recent weeks, as coal moisture has climbed to 10-11%, pulverizer inlet gas temperatures increased an average of 65 to 75 degrees. A significant increase in mill fires was noted and differential pressures were reaching alarm limits.

Concerns also exist with regard to primary air fan capacity. Due to the reported 'clumping' tendency of the Wyoming coal, greater fan capacity may be required to provide proper classification at required fuel flows.

Six mill operation with current coal characteristics is often marginal. The analyses of the Wyoming coal suggest that six mill operation may be impossible.

BLENDING-Reliable blending requires a highly reliable system. This includes availability of on-site equipment and consistency of coal inventories.

There is guarded optimism that the rotary plow feeder reliability can be improved significantly. However, the degree of reliability required to effectively blend coal has not yet been demonstrated by the reclaim system in general.

IPSC has had considerable difficulty in maintaining a consistent fuel reserve in the active reclaim area. Available coal quantities would have to be maintained within much tighter tolerances than has occurred to-date.

SLAGGING/FOULING-Slagging problems have been reported by one utility (NIPSCO) burning the coal in question. Reflective build-up throughout the back pass produced heat transfer problems according to Mr. Larry Bonner of that company. (219) 853-6956 Resolution of these problems required the unit to be shut down.

It appears that the use of Wyoming coal may require significant alterations in existing equipment and/or modes of operation. Whether desirable or not, these issues should be thoroughly investigated.

For your information
I. Stein

Babcock & Wilcox

a McDermott company

Power Generation Group

20 S. Van Buren Avenue
P.O. Box 351
Barberton, OH 44203-0351
(216) 753-4511

February 1, 1989

Intermountain Power Project
Department of Water & Power
City of Los Angeles
P.O. Box 111, Room 658
Los Angeles, CA 90051

Attn: Mr. T.H. McGuiness

Re: Intermountain Power Project
B&W Ref: RB-614/615
Subject: Coal Evaluation

Gentlemen:

At the request of Bill Ingalls and Raffi Krikorian, three coals samples were analyzed by B&W for the primary purpose of determining slagging and fouling indices per B&W's established standard methods. Fuel testing included determination of proximate and ultimate analysis, gross heating value, ash fusion temperatures (oxidizing and reducing), spectrographic ash analysis, and grindability. The three coal samples were labeled Coal A, Coal B, and Coal C. Coal A was identified by IPP as being coal currently in use at our contract, RB-614/615. No data concerning the origin of Coals B or C was provided. According to previous conversations with IPP, Coals B and C are candidate coals being considered for firing on these units.

The analysis data for the three coal samples is attached to this report. Also attached is a table of calculated results which are pertinent to the discussion that follows.

COAL RANK

Coal ranks were determined in accordance with ASTM specifications. In the case of the three fuels tested, ranking is somewhat complicated by the fact that all three coals fall into the classification range where the rank cannot be specifically defined by proximate analysis data. All three coals have moist, ash free Btu values in the range of 11,000 to 13,000 Btu/lb. ASTM ranking criteria assigns both the High Volatile C Bituminous classification and the Subbituminous A classification to this Btu range. Generally, the agglomerating characteristics of the coal are used to differentiate between these adjacent groups. Agglomerating coals are commonly ranked in the High Volatile C Bituminous group, while non-agglomerating coals are commonly ranked in the Subbituminous A group. When this issue became apparent, we performed additional tests in accordance with ASTM standard D388 to determine the agglomerating characteristics of the coals. Coal A was found to be agglomerating while Coals B and C were non-agglomerating. This would result in a High Volatile C Bituminous rank for Coal A and Subbituminous A for Coals B and C. It should be noted, however, that there are some non-agglomerating coals in bituminous classifications so the specific rankings in this "gray area" are not hard and fast. However, the specific ranks of the coals are not critical to the determination of slagging and fouling characteristics which are most dependent upon the coal ash chemistry.

February 1, 1989

SLAGGING AND FOULING CHARACTERISTICS

The slagging and fouling indices developed by B&W are specific to the type of coal ash being considered. There are two major coal ash classifications, i.e. "eastern" and "lignitic". Classification is determined by the calculation of the lignitic factor which is the ratio of the percent by weight of calcium and magnesium in the coal ash to the percentage of iron. When this ratio is less than 1 the ash classification is eastern, when the lignitic factor is greater than 1 the ash classification is lignitic. This distinction is critical for the selection of correlations to be used for determining slagging and fouling characteristics. Per the above the ash is characterized as lignitic for Coals A and C and eastern for Coal B.

SLAGGING

The slagging factor (R_s) for a lignitic ash coal is calculated from a weighted average of the initial deformation and hemispherical softening temperatures of the coal ash. Classification is as follows:

R_s GT 2250	= medium slagging
R_s 2250 - 2100	= high slagging
R_s LT 2100	= severe slagging

Based on the above, the lignitic ash coals, A and C, classify as high and medium respectively.

The slagging factor for an eastern ash coal is calculated as the product of the base to acid ratio of the coal ash and the percent by weight of sulfur in the coal on a dry basis. Classification is as follows:

R_s LT 2.0	= medium slagging
R_s 2.0 - 2.6	= high slagging
R_s GT 2.6	= severe slagging

Coal B, which has an eastern type ash, is classified on this basis as medium slagging.

FOULING

The fouling factor (R_f) for a lignitic ash coal is determined by the weight percent of sodium (Na) in the ash analysis. Two classification criteria are utilized, depending on the base to acid ratio of the coal ash. For ash with a low B/A, classification is as follows:

R_f LT 1.2	= medium fouling
R_f 1.2 - 3.0	= high fouling
R_f GT 3.0	= severe slagging

Coal A falls in this category and is classified as high fouling with a sodium content of 1.46.

Ash with a low base to acid ratio is classified for fouling as follows:

R_f LT 3.0 = medium fouling
R_f 3.0 - 6.0 = high fouling
R_f GT 6.0 = severe fouling

Coal C with a high B/A and a sodium content of .84 is classified as medium fouling on this basis.

The fouling factor for an eastern ash coal is calculated as the product of the base to acid ratio and the weight percent of sodium in the ash. Classification is as follows:

R_f LT 0.5 = medium fouling
R_f 0.5 - 1.0 = high fouling
R_f GT 1.0 = severe fouling

Coal B, with R_f of .09, is classified on this basis as medium fouling.

SPECIAL NOTE ON COAL C

Per the above, in accordance with our standard predictive methods for coals with lignitic ash, Coal C is classified as medium slagging and medium fouling. Relatively recent experience with western coals from certain areas in Montana and Wyoming indicate that these coals do not behave in accordance with the standard indices and special considerations are required. These coals have exhibited the potential to form thin, white, highly reflective ash deposits on upper furnace walls. These deposits impede radiant heat transfer in the furnace resulting in elevated furnace exit gas temperatures (FEGT). Problems with severe superheater leading edge slagging can result from the higher than expected gas temperature.

At present, there is no proven method of determining if a particular ash will exhibit reflective properties with a high degree of certainty. However, a number of parameters associated with Coal C such as its high Base/Acid ratio, lignitic factor and calcium content are common to other coals known to have reflective ash properties. As noted above, Montana and Wyoming coals from certain seams are known to have reflective properties. IPP declined to advise the origin of these coals prior to issuing this report so no evaluation can be made on this basis.

FLYASH EROSION POTENTIAL

Based on the analyses data available, a limited evaluation of the erosiveness of the various coal ash can be made. Factors considered from the coal and ash analysis include ash loading, expressed as pounds of ash per million Btu, and the sum of silica and alumina in the ash. High ash loadings and high silica/alumina contribute to increased flyash erosion. In convection pass design, flue gas velocity limits are established based, in part, on these factors.

Table 1 shows the ash loading Si + Al calculations for the three coals tested. Note that Coal A has both the highest ash loading and the highest total silica/alumina of the three coals. Ash loadings are significantly less for Coals B and C. Coal C also has a significantly lower proportion of erosive elements.

IGNITION AND STABILITY

B&W has developed a number of indices to evaluate ignition and stability characteristics for the wide range of fuel/burner/furnace combinations encountered. Presently, our most commonly used index is the B&W Ignition Factor.

This factor provides a relative indication of ignition and stability characteristics for PC firing by evaluating volatile heat release and ignition burden factors. Experience has shown a very good correlation between the ignition factor and observed performance over a wide range of combustion system configurations and coal types.

Generally, fuels having ignition factors of 120 or greater can readily be utilized in conventional furnaces with standard circular or Dual Register Burners. Ignition factors for the three fuels included in this study are listed on Table 1. Note that the factors for all three fuels significantly exceed the minimum requirements.

SUMMARY

Aside from the question concerning the potential that Coal C has a reflective ash, the evaluation indicates that Coals B and C could readily be used to replace Coal A. On the basis of the standard indices evaluated these coals exhibit advantages with respect to Coal A in terms of slagging and fouling performance and flyash erosion potential. The potential for reflective ash with Coal C will require additional evaluation since the standard indices do not adequately predict performance when reflective ash effects are involved. Information concerning the source of Coal C will help to resolve this issue.

Very truly yours,

Carl O Palmberg

C.A. Palmberg, Contract Manager

CAP:nk

cc: RK Krikorian - IPP, LA
GT Rose - IPP, Delta

P.S. - Per my 1/27/89 telecon with Bill Ingalls, IPP is sending us one more candidate coal ("Coal D") for similar analysis work. B&W will report on "Coal D" in a separate report. Please initiate a change order to cover this additional work (price is the same as quoted in my 11/23/88 letter).

Table 1

	Coal A	Coal B	Coal C
Coal Rank	HVBC/SUBA	HVBC/SUBA	HVBC/SUBA
Lignitic Factor	1.91	.85	4.36
Ash Type	Lignitic	Eastern	Lignitic
B/A Ratio	.31	.31	1.19
Sulfur % Dry	.66	1.04	.60
Na %	1.46	.30	.84
R_s	2184 (high)	.32 (medium)	2390 (medium)
R_f	1.46 (high)	.09	.84 (medium)
# Ash/10^6 Btu	6.4	4.7	4.1
Si + Al	67.92	66.68	36.15
Ignition Factor	379	240	315

INTERMOUNTAIN POWER
DELTA, UTAH
ACG-89-6366-01
JANUARY 13, 1989

Sample No.	C-20112		C-20113	
Description	COAL A (Skyline) 12/5/88		COAL B (Bitter Creek) 12/5/88	
Basis	As Received	Dry	As Received	Dry
Total Moisture, %	11.24	—	16.06	—
Proximate Analysis, %				
Moisture	11.24	—	16.06	—
Volatile Matter	39.84	44.89	35.84	42.70
Fixed Carbon	41.57	46.83	43.16	51.41
Ash	7.35	8.28	4.94	5.89
Gross Heating Value Btu per Lb.	11453	12903	10569	12591
Btu per Lb. (M&A Free)	--	14068	--	13379
Ultimate Analysis, %				
Moisture	11.24	—	16.06	—
Carbon	62.71	70.65	60.73	72.35
Hydrogen	4.83	5.44	4.21	5.02
Nitrogen	1.33	1.50	1.19	1.42
Sulfur	0.59	0.66	0.87	1.04
Ash	7.35	8.28	4.94	5.89
Oxygen (Difference)	11.95	13.47	12.00	14.28
Total	100.00	100.00	100.00	100.00

INTERMOUNTAIN POWER
DELTA, UTAH
ACG-89-6366-01
JANUARY 13, 1989

Sample No.	C-20114	
Description	COAL C (Shoshone) 12/3/88	

Basis	As Received	Dry
Total Moisture, %	12.82	---
Proximate Analysis, %		
Moisture	12.82	---
Volatile Matter	38.99	44.72
Fixed Carbon	43.60	50.01
Ash	4.59	5.27
Gross Heating Value Btu per Lb.	11150	12790
Btu per Lb. (M&A Free)	—	13502
Ultimate Analysis, %		
Moisture	12.82	—
Carbon	63.61	72.96
Hydrogen	4.54	5.21
Nitrogen	1.53	1.75
Sulfur	0.52	0.60
Ash	4.59	5.27
Oxygen (Difference)	12.39	14.21
Total	100.00	100.00

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

DRAFT

TO: S. Gale Chapman

FROM: Dennis K. Killian

DATE: January 22, 1997

SUBJECT: Recommendation on Wyoming Coal

In preparation for the anticipated receipt of Wyoming and Colorado coal, representatives of Technical Services, Operations and Maintenance got together to discuss information gathered to-date. The following recommendations were produced from this discussion:

1. Test the Colowyo coal first to ensure more accurate analysis.

2. Separate initial shipments of Colowyo and Antelope coal.

3. Obtain samples from both proposed mines for in-house analysis.

4. Avoid scheduling these trains in severe winter months.

Coal from the Antelope mine and adjacent seams is burnt at several plants throughout the united states on a continuous, unblended basis. These plants have learned to adjust to the added difficulties associated with this fuel, as can we. However, due to the marked differences in required operating procedures associated with the Antelope fuel, it would be wise for us to move into this mode in a carefully controlled manner.

<u>ColoWyo Coal First</u>
We recommend that, if possible, the initial set of trains be scheduled from the CoLoWyo Mine. The ColoWyo coal is expected to have minimal negative impact on our boiler. The Antelope coal, however, could have significant impact on our boiler and operating procedures based on current information. Burning the ColoWyo coal first will allow a more accurate assessment of the impact of this fuel on our equipment.

<u>Separate Shipments</u>
The original boiler design specification included one coal analysis ('F' coal) which is a reasonable approximation of the coal from the Antelope mine. The design specification sets a blend limit of 50% on this type coal. Operations is prepared to

meter this coal to the units in reasonable increments up to this maximum limit.

In order to accurately handle and assess the impact of these fuels we recommend that a separation of at least two weeks occur in scheduling the end of the first series of ColoWyo trains and the beginning of the initial Antelope trains. This will allow critical time to fully assess the impacts and normalize system operations as much as possible before introducing another set of variables.

In-house Sample Analysis

We recommend that samples be obtained for in-house verification of the analyses we received from the owner of the mines, (Kennecott). We are particularly interested in confirming values for percent fines, fusion temps, and BTUs etc.

Avoid Winter Shipments

Both of these coals have considerably higher moisture content than we typically see. We recommend that steps be taken to avoid scheduling any of these trains in the most severe winter months.

In preparing to receive the Antelope coal, there are several positive design aspects within our boiler, coal handling and fuel preparation systems that place us in a better position than most. However, modifications in hardware and O&M procedures at those plant converting to PRB Subbituminous have been considerable. Contact James Nelson X6464 with questions.

S. Gale Chapman
President and COO

cc: Bob Davis
George Cross
Joe Hamblin
Dale Hurd
Mike Alley
Stan Smith

Pelletized Coal Test

About 67 tons of Pelletized coal was test via Unit 1 A mill for 1.5 hour duration. Following are listed of observations:

1. Average motor current was 60 amps. This is normal
2. Average mill DP was 11 wc. This is normal.
3. Average PA inlet temperature was 382°F. This is normal.
4. Average PA outlet temperature was 151°F. This is normal.
5. Mill vibration is relatively high. We could feel the rumbling.
6. Flames look normal.

The test was started at 2:30 pm and finished at about 4 pm. Normal coal was introduced into the silo and A mill at about 4:15 pm. With the normal coal burning, the following items was observed:

1. PA inlet temperature increased to 411°F. This may be caused by wet coal due to the past rainy days. Note that there are two other mills running high in inlet temperature also.
2. Mill vibration is significantly reduced.
3. Average mill DP was 11 wc. Unchange from Pelletized coal.
4. Average motor current was 64 amps or 2 amps increased from Pelletized coal.

Since the tested coals are relatively much finer and with the fixed spring loading that sets for our existing coal grindability (25 short ton per roll), there would not be enough coal bed and recirculations inside the mill. Lesser coal bed would cause higher mill vibration. Finer coal would also require less grinding power, therefore, reducing the mill power consumption or motor amps.

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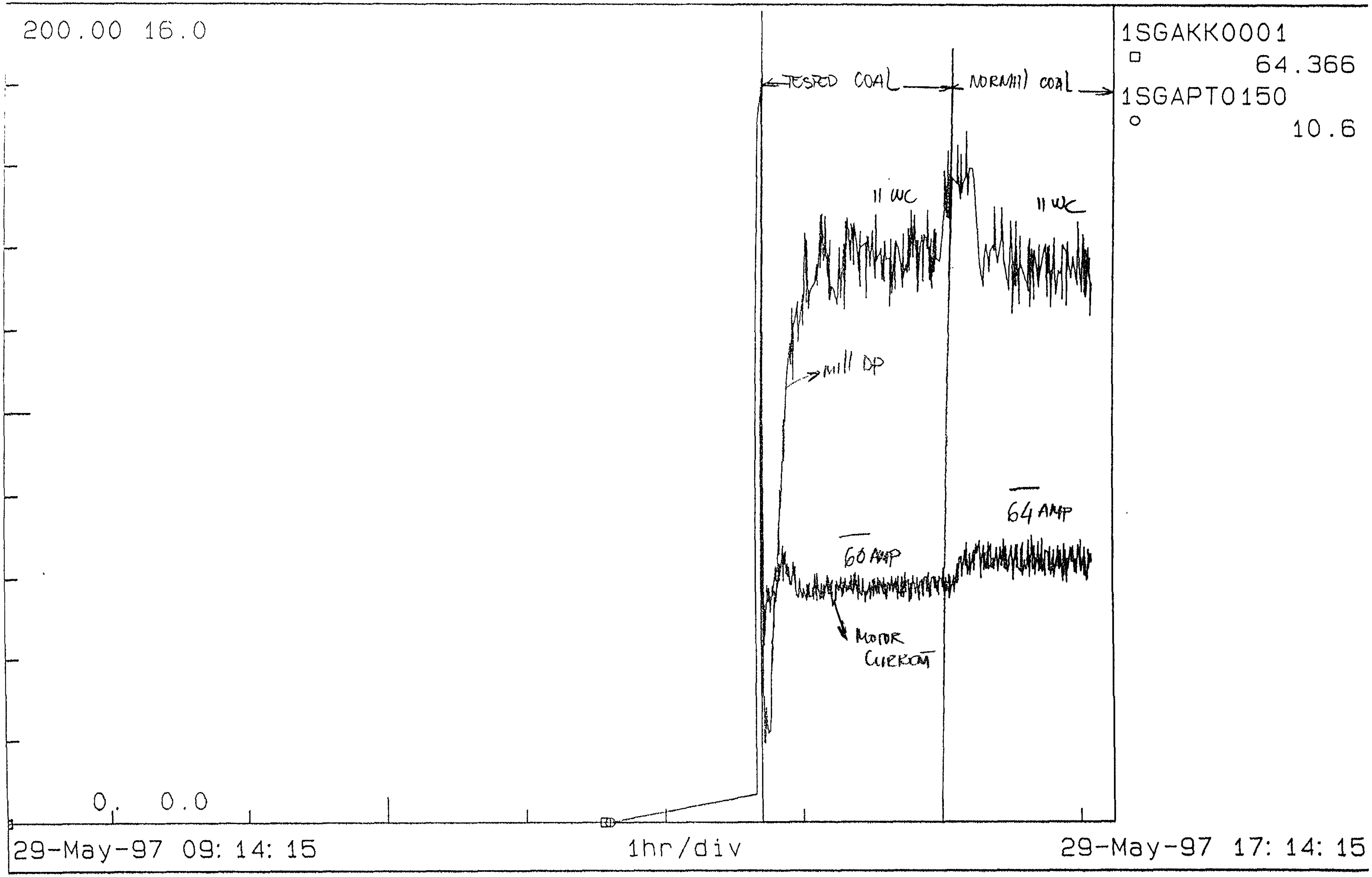

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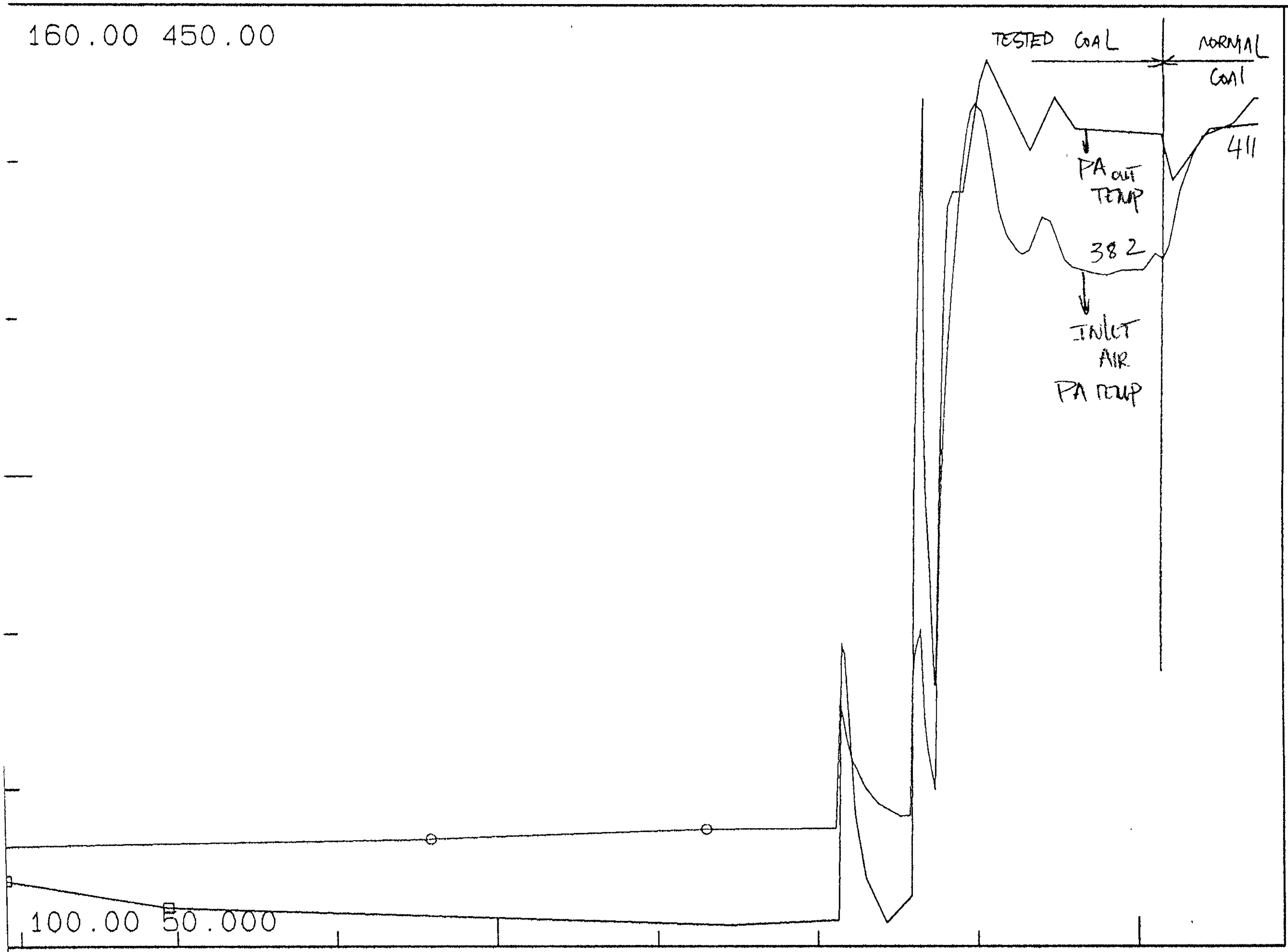

1SGATE0655 □ 152.53

1SGATE0639 ○ 411.30

29-May-97 08:54:31 1hr/div 29-May-97 16:54:31

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IP12_004843

COAL ANALYSIS FINAL REPORT

IPSC FUELS LAB

Sample Identification: COVOL INCOMING RAW 5-20-97

Lab Sample Number: 21018

Lab Analyst Intials: RAH

Date: 970523

Short Proximate Analysis

	As Received		Dry Basis	
% Total Moisture	16.84%		XXXX	
% Ash	13.71%		16.48%	16.23
% Sulfur	0.68%		0.81%	0.81
BTU/lb	9891		11894	11865
Moisture Ash Free BTU/lb	0.0091	14241	0.0110	RF
% Residual Moisture		1.71% 1.81		

COMMENTS: PRODUCT SEEMS TO BE VERY INCONSISTENT IN QUALITY, SEE FINISHED PRODUCT FOR 5-20-97.

IP12_004844

COAL ANALYSIS FINAL REPORT

IPSC FUELS LAB

Sample Identification: COVOL FINISHED PRODUCT 5-20-97

Lab Sample Number: 21019

Lab Analyst Intials: RAH

Date: 970523

Short Proximate Analysis

	As Received	Dry Basis
% Total Moisture	8.31%	XXXX
% Ash	19.37%	21.13% (21.15
% Sulfur	0.73%	0.79% (0.77)
BTU/lb	10329	11265 (11271)
	0.0133	0.0145
Moisture Ash Free BTU/lb	14282	
% Residual Moisture	1.87% (1.99)	

COMMENTS:

INTERMOUNTAIN POWER SERVICE CORPORATION
TRAIN SHIPMENTS, MONTHLY COMPOSITE

DATE: May 8, 1997

MONTH OF:

MINE: **U. S. Fuel Briquettes**

CONTRACT NUMBER:

SHIPMENT NUMBERS:

TOTAL TONNAGE: TOTAL SHIPMENTS:

COAL ANALYSIS				
IPSC LAB MINE SAMPLE			MINE SPLIT	
LAB NO. 20737			LAB NO. xxxx	
	AS RECEIVED	DRY BASIS	AS RECEIVED	DRY BASIS
%MOISTURE	3.40	xxxx	xxxx	xxxx
%ASH	15.02	15.55	xxxx	xxxx
%VOLATILE	41.56	43.02	xxxx	xxxx
%FIXED CARBON (by diff.)	40.02	41.43	xxxx	xxxx
%SULFUR	0.68	0.70	xxxx	xxxx
BTU/LB	11720	12133	xxxx	xxxx
%FLUORINE	0.0097	0.0100	xxxx	xxxx
	HGI =	xxx	HGI =	xxx

ASH ANALYSIS		
	IPSC LAB	MINE SPLIT
%SODIIUM OXIDE, Na20, IGNITED BASIS =	1.09	xxxx
FUSION TEMP., REDUCING ATMOSPHERE; ID=	2093	xxxx
ST=	2245	xxxx
HT=	2318	xxxx
FT=	2552	xxxx

IP12_004846

REPORT
COVAL COAL BRIQUETTES

Compiled by Gordon Bigham
6/4/97

On Wednesday May 28,1997 we received a shipment of 86.4 tons of coal briquettes from COVAL company.

Upon arrival the briquettes appeared to be broken up by handling. There were a lot of fines.

On Thursday May 29, 1997 we performed several tests to observe performance of the briquettes.

First, the LeTourneau driver ran over a small portion of the briquettes. This resulted in crushing and compaction of all the briquettes to the full depth of the briquettes (about 18 inches).

Then we poured water on some of the briquettes to see the effect. Briquettes immersed in water dissolved over a one to two hour period. Water poured on the compacted area either puddled up or ran off, it did not soak in at all. Water poured on the uncompacted briquettes ran down into the pile immediately.

Next we pushed the coal into the reserve reclaim hopper and sent it to Unit 1A coal silo via the A conveyor belts. A sample was taken from the 18A conveyor a sieve analysis and a short proximate analysis was performed (both tests shown below).

The sieve analysis shows the large amount of fines from the coal briquettes. During dry conditions this will cause a much higher dust loading on our dust collection systems. We expect the dusting to be similar to the Antelope coal tested recently.

The proximate analysis shows the variations in quality of the product. Four proximate analysis were done in May 1997 and the variations are shown below. BTU, Ash and Moisture content varied widely. We are also concerned about the potential for wide variations in undesirable constituents like Fluorine, Sodium, and other contaminants. High Fluorine levels will cause bag damage in the baghouses. Other contaminants may affect boiler slagging or our ash quality for sale.

The chemical binder used in the briquettes left a residue coating the Coal Lab's sample mill. It is a concern that this same residue may build up in the pulverizers and burner lines greatly increasing the fire hazard and maintenance required in those areas.

MGN

MEMORANDUM

GMB

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: S. Gale Chapman

FROM: Dennis Killian

DATE: June 3, 1997

SUBJECT: Coal Briquette Test Results

We recommend that coal briquettes not be used at IGS for several reasons.

1. Too many fines. Compared to other spot market coal we are buying, the briquettes break down into fines. Dusting will be a problem if we bring large quantities of briquettes on site.

2. The briquette quality is not consistent. BTU content was lower than Utah coal and BTU, Ash and Moisture varied excessively. Such variations may cause operational problems if this product is run without blending. The potential also exists for unacceptably high concentrations of other impurities that will cause equipment or ash quality problems.

3. We expect accelerated vibration damage to the pulverizers due to the extreme softness of the briquettes. They will rumble constantly.

4. The briquettes are difficult to store. They are prone to spontaneous combustion and can not be compacted without completely being crushed to powder.

5. Grinding the briquettes in the sample mill caused the binder chemical to coat the entire inside of the mill. It is possible that this coating could become a fire hazard in the units. More testing is required to determine the effects of the binder chemical on our units.

For more information please contact Gordon Bigham at Extension 6483.

*GMB:MGN:dh
Attachments

IP12_004848

SIZE COMPARISON
COVAL COAL DUST BRIQUETTES vs COLOWYO COAL

Coal Sizing by Weight Percent		
	COVAL	COLOWYO
Retained on 1-1/2" Square	0	9.7
Retained on 3/4" Sq Passing 1-1/2"	10.1	27.3
Retained on 1/2" Sq Passing 3/4"	6.2	13.3
Retained on 1/4" Sq Passing 1/2"	9.9	18.5
Retained on 30 mesh Passing 1/4"	25.0	23.4
Retained on 60 mesh Passing 30 mesh	12.0	3.6
Retained on 100 mesh Passing 60 mesh	12.3	1.4
Retained on 200 mesh Passing 100 mesh	10.9	1.5
Passing 200 mesh	13.6	1.4

Coal Sizing by Cumulative Weight Percent		
	COVAL	COLOWYO
Retained on 1-1/2" Square	0	9.7
Retained on 3/4" Sq Passing 1-1/2"	10.1	36.9
Retained on 1/2" Sq Passing 3/4"	16.3	50.2
Retained on 1/4" Sq Passing 1/2"	26.2	68.7
Retained on 30 mesh Passing 1/4"	51.2	92.1
Retained on 60 mesh Passing 30 mesh	63.2	95.7
Retained on 100 mesh Passing 60 mesh	75.5	97.2
Retained on 200 mesh Passing 100 mesh	86.4	98.6
Passing 200 mesh	100	100

Variations in Short Proximate Analysis of COVAL Briquettes	
Percent Moisture	3.4 to 16.8
Percent Ash	13.7 to 19.4
Percent Sulfur	0.68 to 0.73
BTU/lb	9891 to 11720

After sampling the coal was sent to Unit 1A Coal Silo and burned later that day.

The coal was burned in about 1-1/2 hours of pulverizer operation. The mill ran 4 amps lower than normal due to the ease of grinding the briquettes, the differential pressure was unchanged, but the vibration was higher(see graph). The wheel loading should be reduced to run unblended coal briquettes on a continuous basis to reduce vibration damage to the pulverizers. Pulverizer inlet temperatures were slightly lower with the briquettes since they were dryer than the normal coal supply at that time (see graph).

The burner flame was normal; no problems were noted.

Since the test Bill Engles of the LADWP fuels group mentioned that the briquettes are prone to spontaneous combustion. Therefore it seems that compaction is a must for long term storage of this kind of coal.

<u>CONCLUSIONS:</u>

1. COVAL coal dust briquettes are fragile and break easily during handling.

2. Long term storage will require compaction which will also pulverize the product. This will lead to dusting problems when the material is reclaimed.

3. The product quality varies excessively even within a single production run.

4. The chemical binder may plate out in the pulverizer and burner lines and increase the fire hazard and maintenance required in those locations which are already maintenance intensive.

5.Pulverizer vibration increased when running strait briquettes. This will cause accelerated damage to the pulverizers unless the briquettes are carefully blended with regular coal or the wheel loading is adjusted every time we switch from one type of coal to the other.

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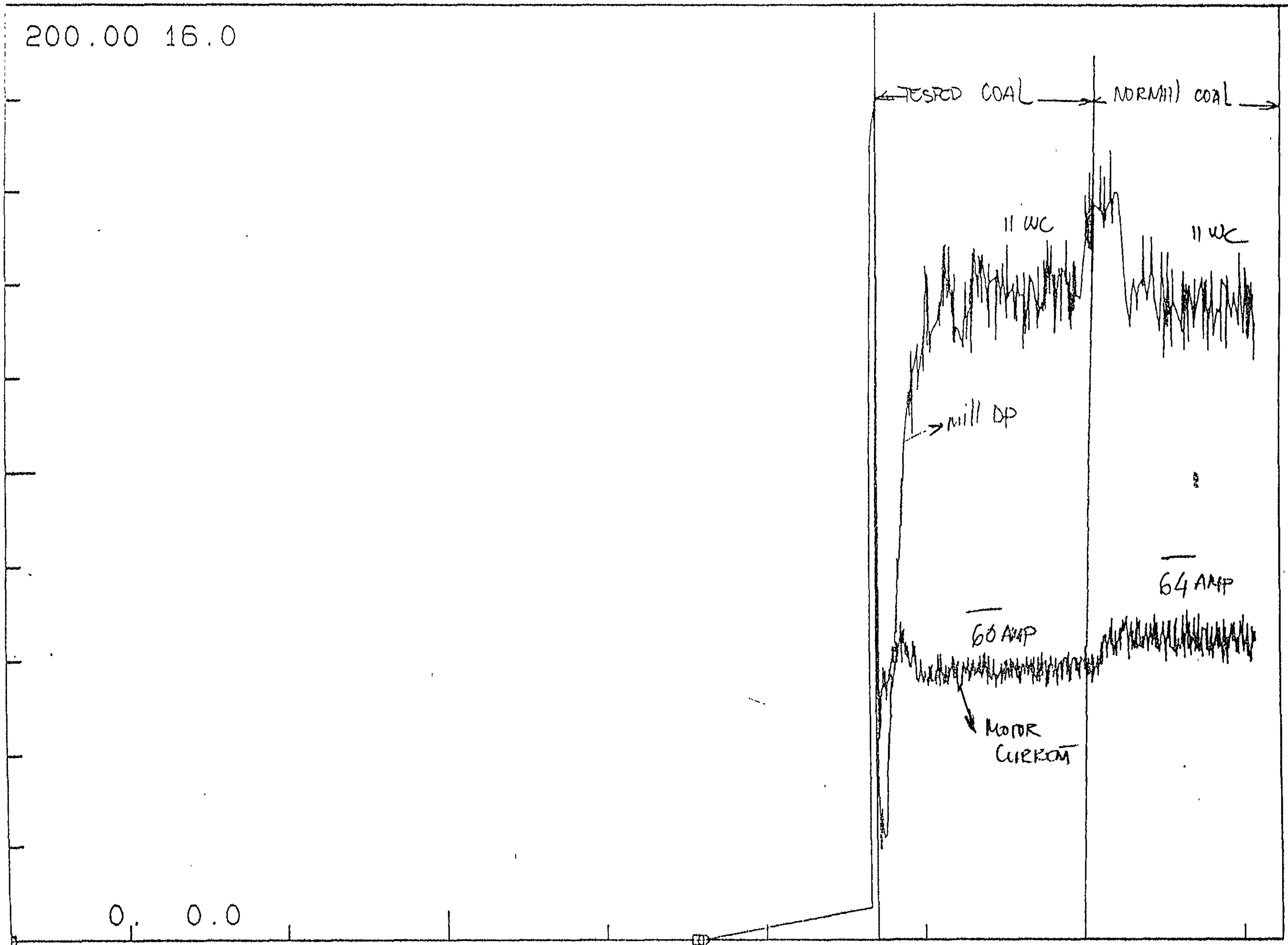

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IP12_004851

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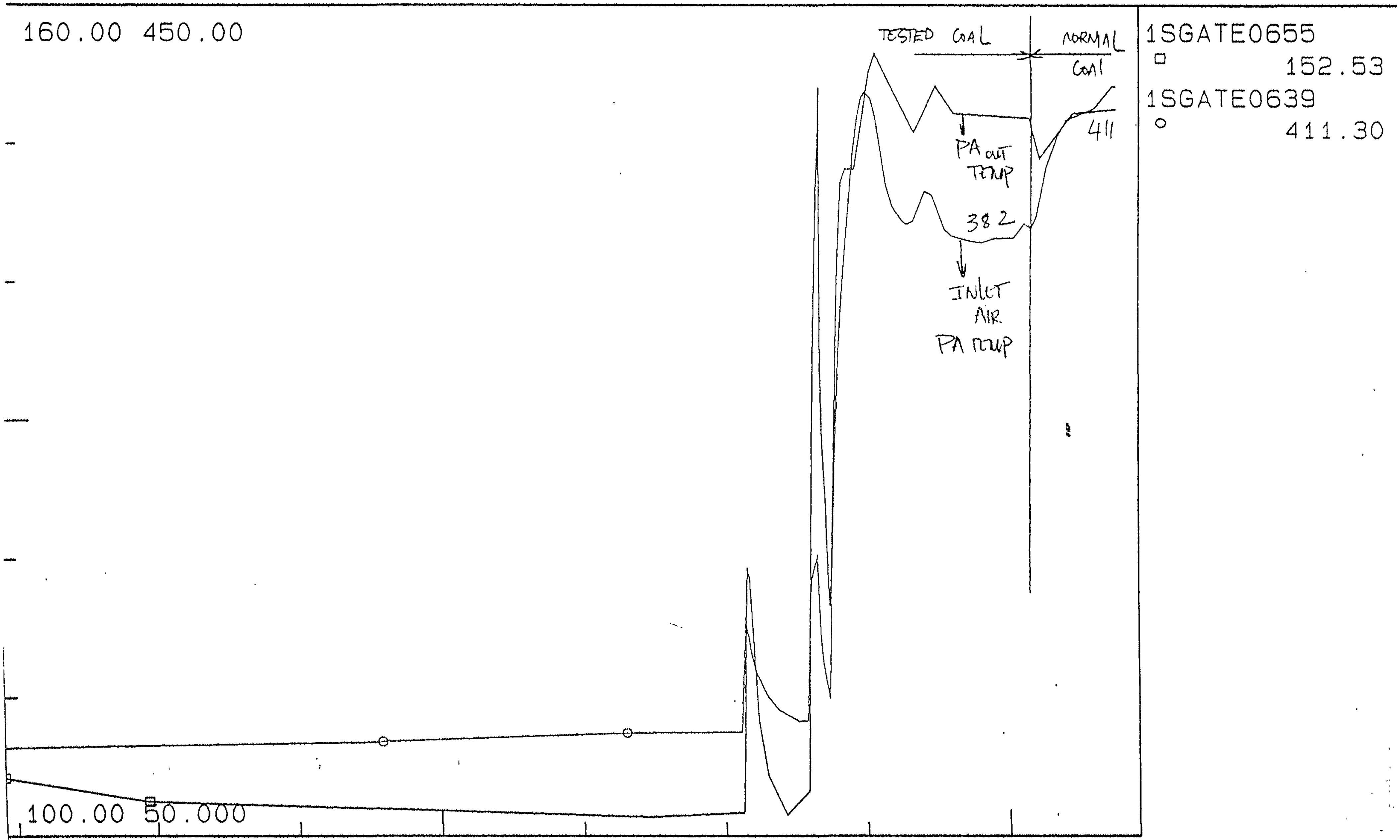

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IP12_004852

MGN ✓

JMB

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: S. Gale Chapman

FROM: Dennis Killian

DATE: May 28, 1997

SUBJECT: Test Plan for Coal Briquettes

Attached is a plan for testing the handling characteristics of the Coal Briquettes scheduled to arrive on site today.

Previous types of briquettes were too soft to handle in our coal handling system because they were reduced to powder too easily.

We believe the briquettes arriving today are more compatible with our system, but would like to make sure before LADWP sends a train load.

If you have questions or concerns please contact Gordon Bigham at Extension 6483.

GMB:MGN:dh
Attachment

IP12_004853

COAL BRIQUETTE HANDLING
TEST PLAN

This is a test to determine the handling characteristics of the COVOL coal Briquettes. We would like to perform the test on Thursday after the coal yard tagging has been removed for filling the units in the afternoon.

1. Two coal trucks will deliver manufactured coal briquettes on Wednesday 28 May 1997.

2. Operations will direct the trucks to dump the coal briquettes near the reserve reclaim hopper.

3. On Thursday afternoon 29 May 1997 at approximately 2:00 pm Lance Lee of LADWP and several people from Technical Services will position themselves in the Coal Yard for the test.

4. We request an FEO to separate 3 to 5 tons of briquettes and run over them with the LeTourneau to see how well they stand up to the weight of the machine.

5. We request the FEO then push all the briquettes into the active reclaim hopper.

6. We then request operations load the coal onto conveyor 4 at normal feeder speeds and transfer it to the units.

7. When the coal arrives on belts 18A and/or 18B please shut off a belt so technical services can sample the coal.

8. After the sample is collected the coal handling system will be ready for normal service.